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Multi-Color Rotary Printing Machine

The present invention relates to a multi-color rotary printing machine

- *in which one printing plate support each is assigned to the colors to be transferred onto the print substrate, whereby said printing plate support supports a printing plate and*
- *can be attached to a mandrel or a cylinder of a rotary printing machine in order to transfer the print image onto the print substrate,*
- *whereby the rotary printing machine has register devices that determine the position of the printing plates with respect to one another.*

Machines of such type are designed, for example, as flexographic printing machines and gravure printing machines. The term "printing plate support" refers to all possible cylinders, sleeves, or even flexible mats that support a printing plate. Thus, for example, a cylinder that supports a printing plate and is supported using bearing pins and/or bearing points is used conventionally in gravure printing. However, in recent times the so-called sleeves that are drawn up over a cylinder are also used in gravure printing just as in case of flexographic printing. Many different colors are used particularly in package printing. As a result, the high demands made on register accuracy play an important role in this context. However, register accuracy also plays an important role in other areas and in the application of other print processes. The still unpublished patent application having the file number 102 54 836. 6-27 and that has also been submitted to the German Patent and Trademark Office addresses this issue of register process in detail.

In the literature relevant to this subject, no mention is usually made of the manner in which the positions of the printing plate supports with respect to one another are

determined before and at the time of the start of the print process. Said positions are determined, for example, in flexographic printing machines of prior art by an alignment of the printing plate – usually an alignment of a printing sleeve to a pin protruding in the radial direction over the peripheral surface of the print cylinder.

The printing sleeve has a recess into which the pin fits with relative accuracy. It is a laborious and time-consuming process for the machine operator to align the printing sleeve correctly. This process is often referred to as pre-register control.

In addition to that, the clearance between the pin and the recess results in inaccuracies during the register control. This clearance strongly increases in direct proportion to the service life particularly of printing plate supports of flexographic printing that are manufactured from plastic and are often replaced. Register errors can often occur and/or multiply even during the ongoing operation if printing plates, while in operation, shift on the mandrels or the cylinders on which they are seated.

Therefore, the objective of the present invention is to improve the register accuracy.

Said objective is achieved by the fact that

the register devices comprise sensors that determine the positions of the printing plate supports in the printing machine.

These sensors can comprise markings, data carriers or the like, referred to in the following as information carriers that are specially intended for this purpose. The simplest form of an information carrier is a simple line-shaped marking. However, these sensors can also scan characteristic surface features of conventional printing plate supports that are not loaded with information carriers – such as the raised edge of a printing plate used in flexographic printing.

The positions of the printing plates can be made accessible to the machine operator, for example, using a suitable interface such as a display, a monitor or a printer. The machine operator can then make corrections in the positions of the printing plates with respect to one another. For this purpose, he will, in the known fashion, manually adjust the drive connections between the drive and the print cylinders or the printing mandrels in case of the longitudinal register adjustment in a printing machine that is equipped with only one drive. In case of directly driven machines that have been disclosed in the patent application Ca 12 23 150, the machine operator can make such adjustments by a

corresponding control of the drives assigned to the respective mandrels or cylinders.

[handwritten:] driving!

It proves to be advantageous if a control unit carries out said control.

A printing plate support is known from the patent application DE 297 20 928 U1

- that supports a printing plate and that can be attached to the mandrel or the cylinder of a rotary printing machine in order to transfer the print image onto the print substrate and
- that contains at least one information carrier from which information can be removed using a read-out device.

In this connection, the printing plate support is a sleeve, the information carrier is a transponder chip and the information stored on the chip characterizes the print image and is related to the printing sleeve itself (print image, color, age etc.). Information of such type is also often imprinted on printing sleeves in the form of plain text or bar codes.

Printing plate supports form a system together with a rotary printing machine according to the present invention if

the information that can be read out automatically is suitable for determining the relative position of the printing plate support on the mandrel or the print cylinder of a rotary printing machine.

Preferred types of arrangement of the information carrier have been specified in the dependent claims. As mentioned earlier, information carriers can also be distinct as pronounced markings on the periphery of the printing plate support. Such markings can be present as notches or coloring in the material of the printing plate support and can be detected using optical sensors. However, this purpose can also be achieved by using a metal strip that is fixed in the material of the printing plate support and that can be detected using a suitable electromagnetic sensor. If such simple markings are designed as a line or a point, they can supply a small amount of information during a rotation of the printing plate support. However, this information is basically sufficient for determining

the angle position of the printing plate support in the peripheral direction (longitudinal register) and the axial position of the printing plate support on the print cylinder and/or on the mandrel (transverse register). However, information carriers that are stretched over large areas of the peripheral surface in the peripheral direction are preferred. Such information carriers can be loaded with larger amounts of information and it is possible that the sensor can record the exact position of the printing plate over a large angular range of the rotation of the printing plate around the mass centroid axis of the mandrel or the print cylinder. This additional information can benefit the quality of the longitudinal register.

Optically recognizable markings can get smudged in the printing operation until it is no longer possible for the sensors to detect them. Therefore, information carriers such as magnetic tapes, transponder dipole chains, sequences of suitable metal structures etc. that can be read out magnetically or electromagnetically are preferred.

The register quality can be increased further if, in addition to the position of the printing plate support, the position of the print substrate is also recorded and used for register control. This is feasible using the processes that are known from prior art and in which the print substrate is provided with register markings whose position is recorded by sensors. For the purpose of studying this process, reference is made again to the still unpublished patent application having the file number 102 54 836.6-27 that has been submitted to the German Patent and Trademark Office.

If information is available both regarding the position of the printing plates as well as the position of the print substrate in the printing machine, it is also possible to take into account, during the register control, additional factors influencing the print quality that stem from a change in the condition of the print substrate (e.g. fan-out and web elongation).

Additional embodiments of the present invention are explained in the present description and in the claims.

Since printing machines per se are known, this description does not contain an illustration of an entire printing machine or of the installation position of a printing plate support according to this invention in a printing machine according to this invention.

In this context, for the purpose of an example, reference has been made once again to the documents cited above and the patent application DE 101 45 957.2 [A1 is added in the

margin]. Printing machines known from prior art and register processes are illustrated in these documents. Only a sensor 3 must be inserted into such printing machines in such a manner that it can detect the position of the printing plate support 1 in the printing machine. The figures illustrate:

Figure 1: a diagram of a printing plate support according to the present invention
Figure 2: a diagram of a printing plate support according to prior art.

Figure 1 illustrates schematically the arrangement of an embodiment of a printing plate support 1 according to the present invention that has an information carrier 2. In this embodiment, the information carrier is an intentionally shaped magnetic tape 2 that is embedded into the printing plate support 1. However, linear magnetic tapes are usually preferred. The sensor 3 is attached at an appropriate place of the printing machine that is not illustrated here. It 3 is suitable for reading out the magnetic tape 2. The sensor 3 transmits an analog signal over the signal line 6 to the control device 7 of the printing machine which subjects the signal to an analog/digital transducer and takes into account the information contained when generating register correction signals for the drives of the printing machine.
The greatest advantage of this embodiment is the simplification of the pre-register control that is carried out according to prior art as mentioned above with the help of a pin.
However, the information that is read out from the sensor 3 can also be consulted during the ongoing print process in order to improve the register control. The figure also illustrates that the printing plate support 1 is a printing sleeve that is drawn up on the print cylinder 5 of the printing machine in the printing operation. Such arrangements are known in flexographic printing. However, they are also used in recent times in gravure printing.
The printing sleeve and/or the printing plate support supports the printing plate 6. In this embodiment, the information carrier is arranged between the edge of the printing plate 6 and a front edge of the sleeve 1.
The arrow 4 indicates the direction of rotation of the print cylinder 5.
Figure 2 illustrates a printing plate support 1 according to prior art that is provided with a recess 7. The printing plate support is designed as a sleeve that is drawn up on the print cylinder 5. When drawing up the printing sleeve on the print cylinder, the machine

operator must ensure that the recess 7 accommodates the register pin 8 of the cylinder 5 that protrudes over the peripheral surface of the print cylinder in the radial direction. Only then can a satisfactory pre-register control be ensured according to prior art.

List of Reference Symbols	
1	Printing plate support
2	Sensor
3	Sensor
4	Arrow
5	Cylinder
6	Printing plate
7	Recess
8	Register pin
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